CE Test Report

Equipment	:	**Bluetooth 5.0 BLE Data Module**
Model No.	:	**BL654**
Brand Name	:	**Laird**
Applicant	:	**Laird Technologies**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**EN 300 330 V2.1.1 (2017-02)**
Received Date	:	**Jan. 30, 2018**
Tested Date	:	**May 02 ~ May 08, 2018**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by: **Approved by:**

James Fan / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

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Release Record

Report No.	Version	Description	Issued Date
ER813002	Rev. 01	Initial issue	Jun. 25, 2018

Summary of Test Results

Ref. Std. Clause	Test Items	Measured	Result
4.3.1	Permitted Range of Operating Frequencies	Note[1]	Note[1]
4.3.2	Operating Frequency Ranges	Note[1]	Note[1]
4.3.3	Modulation Bandwidth	Note[1]	Note[1]
4.3.4	Transmitter H-Field Requirements	Note[1]	Note[1]
4.3.5	Transmitter RF Carrier Current	Note[1]	Note[1]
4.3.6	Transmitter Radiated E-Field	Note[1]	Note[1]
4.3.7	Transmitter Conducted Spurious Emissions	Note[1]	Note[1]
4.3.8	Transmitter Radiated Spurious Domain Emission Limits < 30 MHz	Note[1]	Note[1]
4.3.9	Transmitter Radiated Spurious Domain Emission Limits > 30 MHz	Note[1]	Note[1]
4.3.10	Transmitter Frequency Stability	Note[1]	Note[1]
4.4.2	Receiver Spurious Emissions	Meet the requirement of limit.	Pass
4.4.3	Adjacent Channel Selectivity	For receiver category 1 only	Note[2]
4.4.4	Receiver Blocking Or Desensitization	For receiver category 1, 2 only	Note[2]

Note[1]: This test item is not required since the NFC function is passive only.

Note[2]: This test item is not required since the receiver category is 3.

1 General Description

1.1 Information

1.1.1 Product Details

The following models are provided to this EUT.

Brand Name	Model Name	Product Name	Description
Laird	BL654	Bluetooth 5.0 BLE Data Module	With Printed PCB Antenna
			With Connector Type Antenna

1.1.2 Specification of the Equipment under Test (EUT)

RF General Information			
Frequency Range (MHz)	Modulation	Ch. Frequency (MHz)	Channel Number
13.553 – 13.567	ASK	13.56	1

1.1.3 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Gain (dBi)	Remark
1	Laird	NanoBlue	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
2	Laird	FlexPIFA	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
3	Laird	FlexNotch	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
4	Mag.Layers	EDA-8709-2G4C1-B27-CY	Dipole	IPEX MHF4	2	Connector Type Antenna
5	Laird	mFlexPIFA	PIFA	IPEX MHF4	2	Connector Type Antenna
6	Laird	Laird NFC	NFC	N/A	N/A	Printed PCB Antenna & Connector Type Antenna
7	Laird	BL654-SA PCB printed antenna	Printed PCB	N/A	0	Printed PCB Antenna
8	Walsin	RFDPA870900SBAB8G1	Dipole	SMA	2	Connector Type Antenna

1.1.4 EUT Operational Condition

Supply Voltage	1.8Vdc & 3.3Vdc from host
SW Version	29.1.1.0

1.1.5 Accessories

N/A

1.1.6 Receiver Category

Receiver Category		
☐	1	Highly reliable SRD communication media; e.g. serving human life inherent systems (may result in a physical risk to a person).
☐	2	Medium reliable SRD communication media e.g. causing Inconvenience to persons, which cannot simply be overcome by other means.
☒	3	Standard reliable SRD communication media e.g. Inconvenience to persons, which can simply be overcome by other means (e.g. manual).

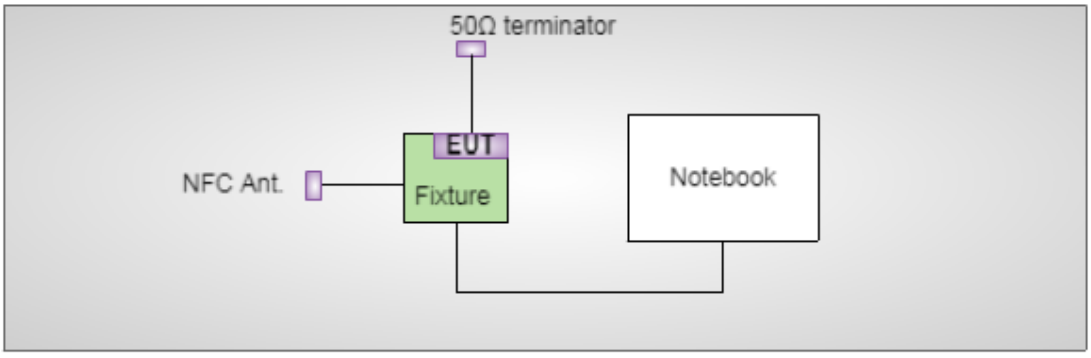
1.2 Local Support Equipment List

Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**S/N**	**Signal cable / Length (m)**
1	Notebook	DELL	Latitude E6440	7MW3Z52	USB, 1m shielded.
2	50Ω terminator	---	---	---	---
4	Fixture	---	---	---	---

Note: Fixture is provided by applicant.

1.3 Test Setup Chart

Test Setup Diagram



1. USB cable, 1m shielded.

1.4 Test Equipment List and Calibration Data

Test Item	Radiated Emissions				
Test Site	Fully-anechoic chamber 1 / (05CH01-WS)				
Tested Date	May 02, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	Agilent	N9010A	MY54200247	Sep. 28, 2017	Sep. 27, 2018
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-524	Oct. 27, 2017	Oct. 26, 2018
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1094	Nov. 10, 2017	Nov. 09, 2018
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170508	Dec. 19, 2017	Dec. 18, 2018
Preamplifier	Agilent	83017A	MY39501310	Nov. 28, 2017	Nov. 27, 2018
Preamplifier	EMC	EMC02325	980146	Oct. 13, 2017	Oct. 12, 2018
Preamplifier	EMC	EMC184045B	980192	Aug. 22, 2017	Aug. 21, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY22626/4	Nov. 24, 2017	Nov. 23, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16608/4	Nov. 24, 2017	Nov. 23, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16617/4	Nov. 24, 2017	Nov. 23, 2018
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-005	Nov. 24, 2017	Nov. 23, 2018
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-006	Nov. 24, 2017	Nov. 23, 2018
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emissions				
Test Site	(10CH02-HY)				
Tested Date	May 08, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESI	838496/008	Sep. 01, 2017	Sep. 01, 2018
Preamplifier	EMC	EMC02325	980225	Jul. 28, 2017	Jul. 27, 2018
RF Cable-R03m	Jye Bao	RG142	CB031	Dec. 29, 2017	Dec. 28, 2018
RF Cable-10m	MTJ	RG223/U+RG8/U	CB026-DOOR	Dec. 29, 2017	Dec. 28, 2018
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 13, 2017	Nov. 12, 2018
Software	Audix	E3	4.03260c	N/A	N/A
Note: Calibration Interval of instruments listed above is one year.					

1.5 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

EN 300 330 V2.1.1 (2017-02)

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty		
Test Item	**Uncertainty**	**Limit**
Radio Frequency	$\pm 3.58 \times 10^{-8}$	$\pm 1 \times 10^{-7}$
RF power, conducted	±0.581 dB	±1 dB
RF power, radiated	±2.704 dB	±6 dB
Temperature	±0.3 ^{o}C	±1 ^{o}C
Humidity	±0.43 %	±5 %

2 Test Configuration

2.1 Testing Condition

Testing Location							
☒	ICC Lab	ADD :	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan (R.O.C.)				
		TEL :	886-3-271-8666	FAX :	886-3-318-0155		
☒	Sporton Lab	ADD :	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.				
		TEL :	886-3-327-3456	FAX :	886-3-327-0973		

Test Condition	Test Site No.	Test Engineer	Test Environment
Radiated Emission above 30 MHz	05CH01-WS	25°C / 65%	Mars Lai
Radiated Emission below 30MHz	10CH02-HY*	22.1°C / 61%	Jack Li

Note: * ICC lab subcontracts this test item to Sporton Lab (TAF:1190).
Sporton Lab is a TAF accreditation test firm and also is an approved provider of ICC lab.

2.2 The Worst Test Modes and Channel Details

Test item	Test Mode	Test Channel (MHz)	Test Configuration
Radiated Measurement	NFC	13.56	1, 2, 3

NOTE:

1) The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Y-plane** results were found as the worst case and were shown in this report.
2) The EUT supports two DC voltage options, DC 1.8V & DC 3.3V. Both options were assessed and **DC 3.3V** was found to be the worst case and was selected for the final test.
3) Test configurations are listed as below:
   1) Configuration 1: Antenna: Laird NFC + EDA-8709-2G4C1-B27-CY
   2) Configuration 2: Antenna: Laird NFC + mFlexPIFA
   3) Configuration 3: Antenna: Laird NFC + BL654-SA PCB printed antenna

3 Receiver Test Results

3.1 Receiver Spurious Emissions

3.1.1 Limit of Receiver Spurious Emissions

Measurement below 30 MHz

Frequency 9 kHz ≤ f < 10 MHz	Frequency 10 MHz ≤ f < 30 MHz
5,5 dBµA/m at 9 kHz descending 3 dB/oct	-25 dBµA/m

Measurement above 30 MHz

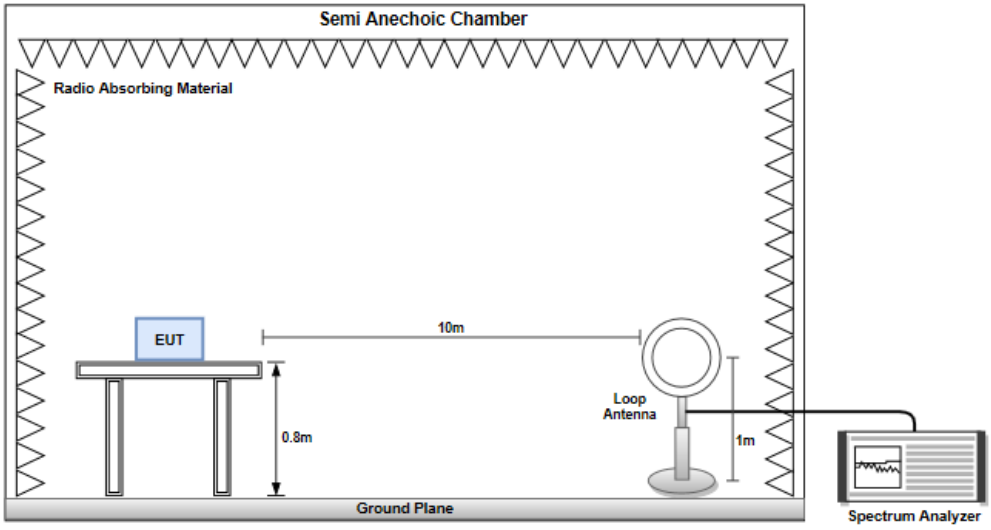
The measured values shall not exceed 2 nW e.r.p. (-57 dBm).

3.1.2 Test Procedures

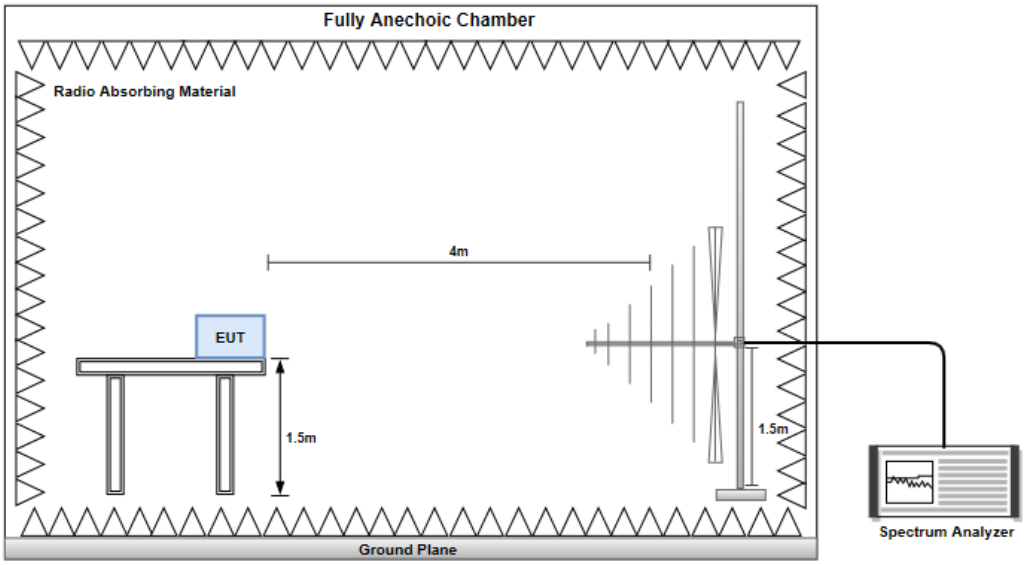
Reference to clause 6.3.1 of EN 300 330 V2.1.1 (2017-02).

3.1.3 Test Setup

Below 30MHz



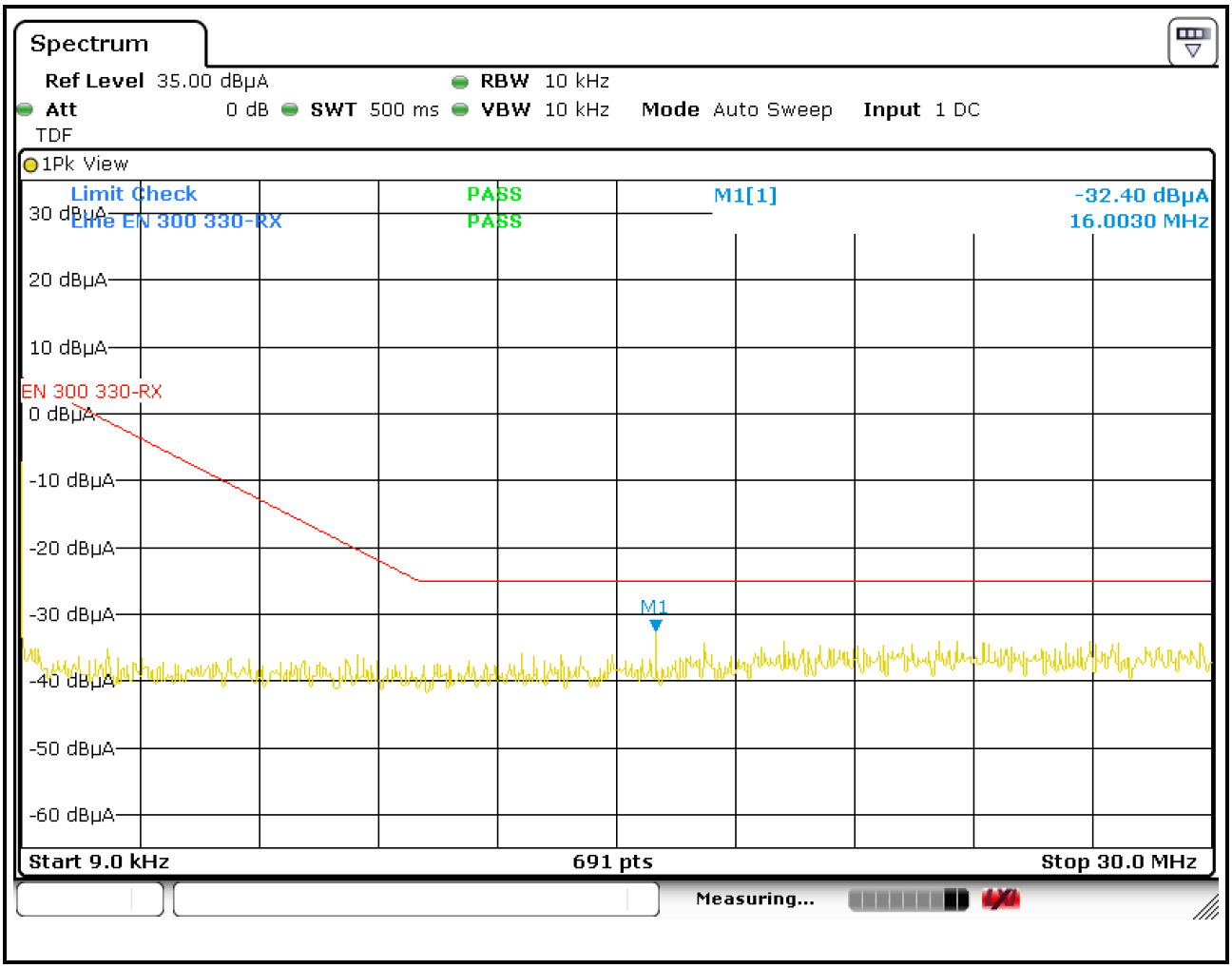
Above 30MHz



3.1.4 Receiver Spurious Emissions (Below 30MHz)

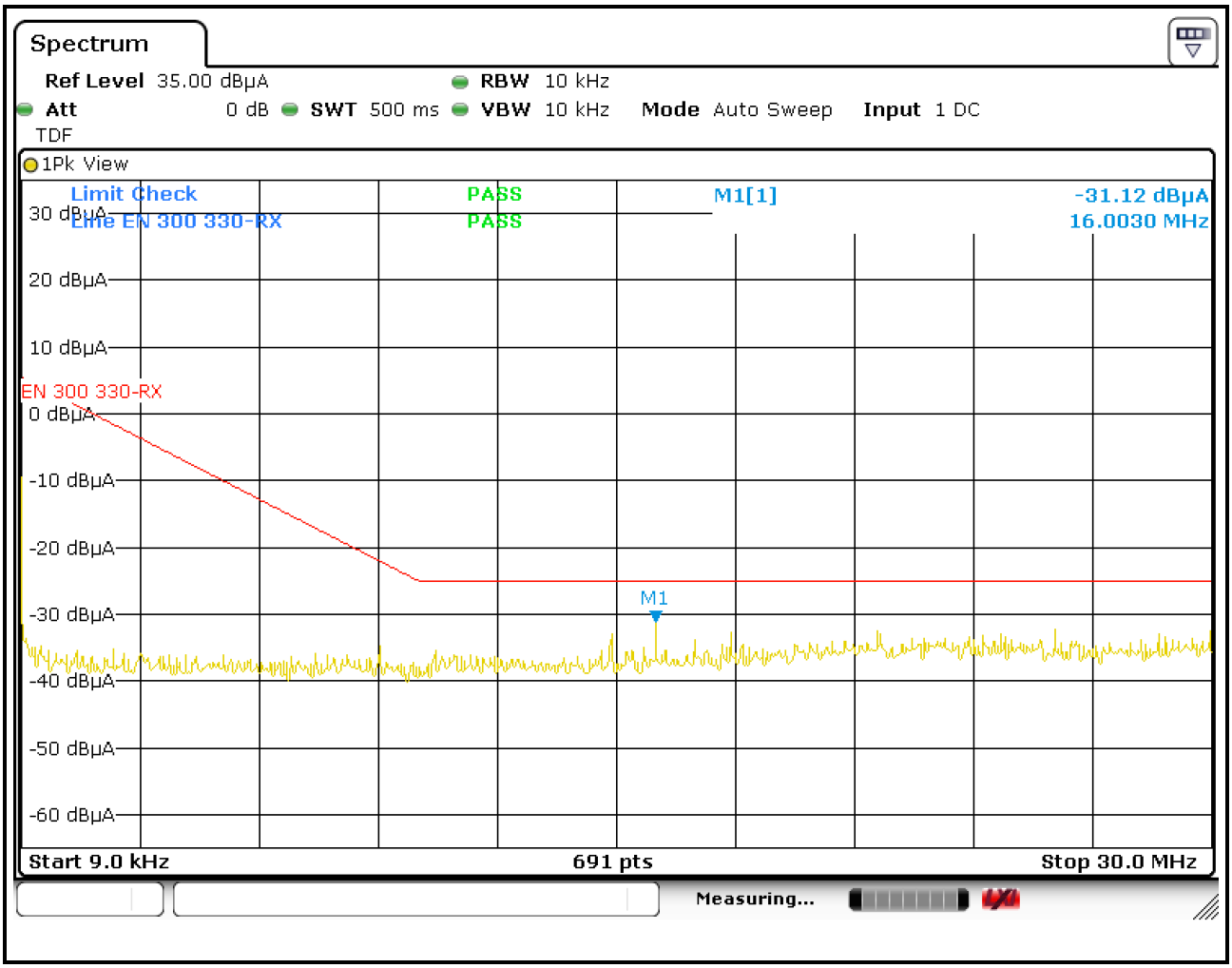
Configuration 1: Antenna: Laird NFC + EDA-8709-2G4C1-B27-CY

Receiver Emissions in the Range from 9kHz~30MHz Result				
Emission Freq. (MHz)	**H-field (dBuA/m at 10m)**	**H-field Limit** (dBuA/m at 10m)	**Level Type**	**Margin** (dB)
16.003	-32.40	-25.00	PK	7.40



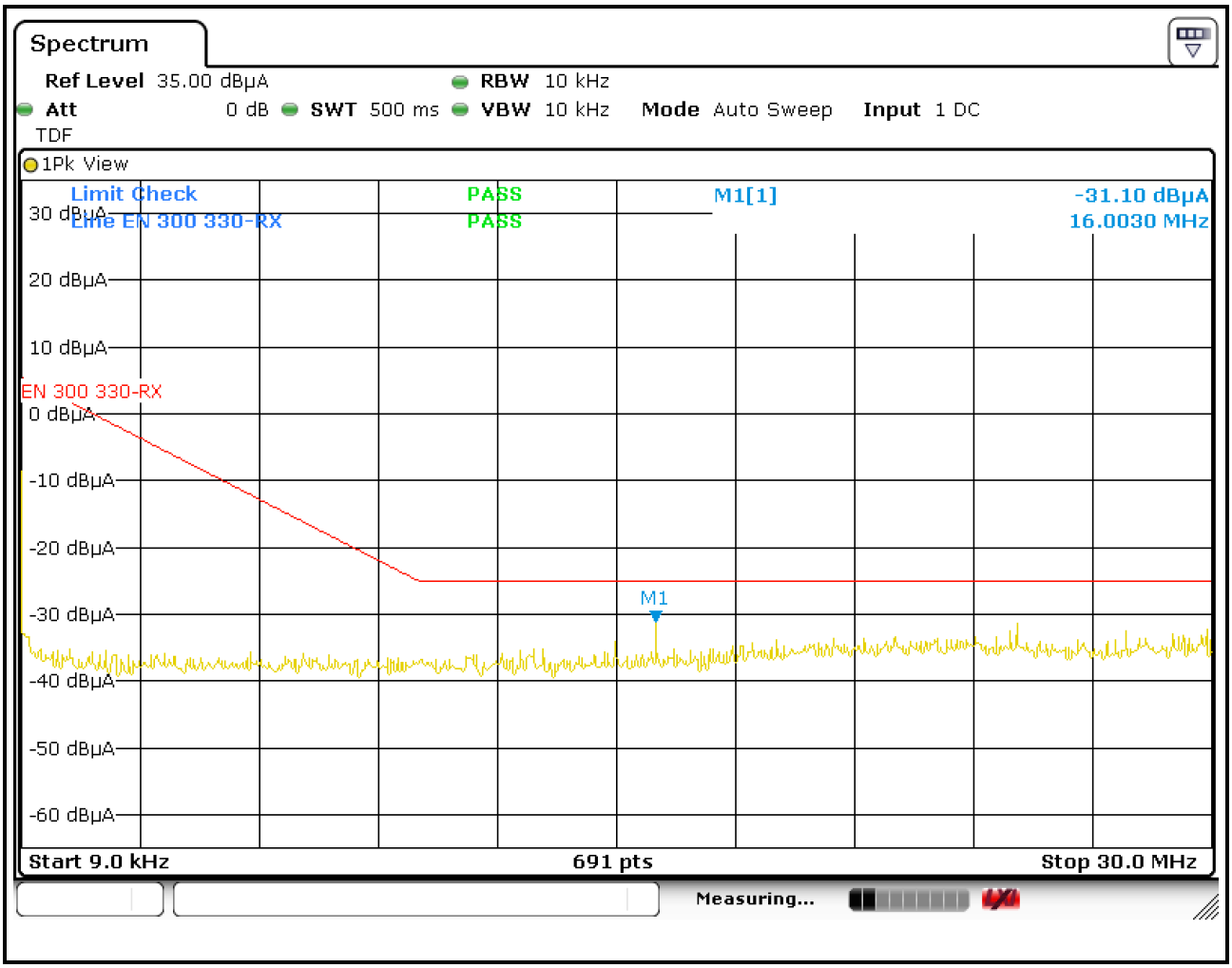
Configuration 2: Antenna: Laird NFC + mFlexPIFA

Receiver Emissions in the Range from 9kHz~30MHz Result				
Emission Freq. (MHz)	**H-field (dBuA/m at 10m)**	**H-field Limit** (dBuA/m at 10m)	**Level Type**	**Margin** (dB)
16.003	-31.12	-25.00	PK	6.12



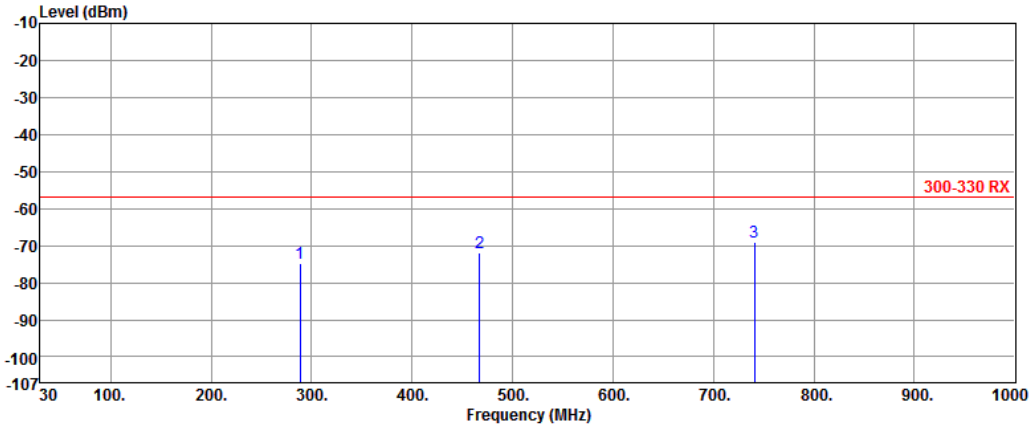
Configuration 3: Antenna: Laird NFC + BL654-SA PCB printed antenna

Receiver Emissions in the Range from 9kHz~30MHz Result				
Emission Freq. (MHz)	**H-field (dBuA/m at 10m)**	**H-field Limit** (dBuA/m at 10m)	**Level Type**	**Margin** (dB)
16.003	-31.10	-25.00	PK	6.10



3.1.5 Receiver Spurious Emissions (Above 30MHz)

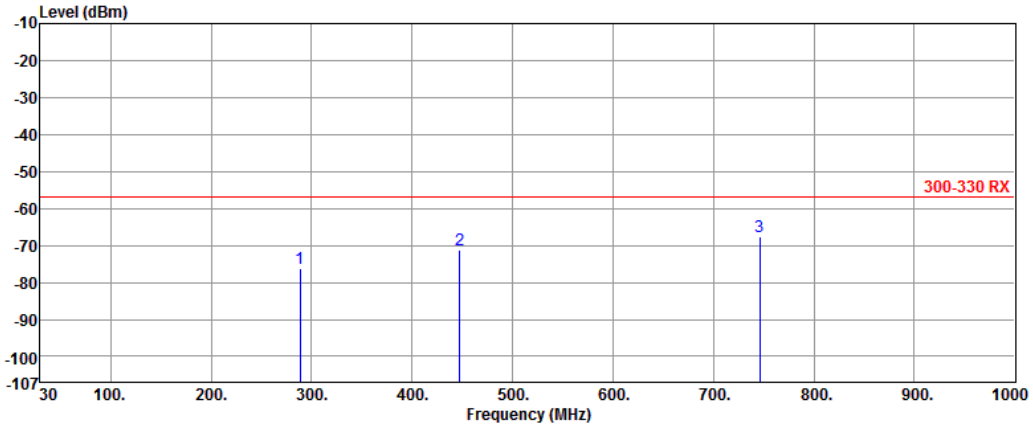
Polarization	Horizontal	Test Configuration	1



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	288.73	-74.72	-57.00	-17.72	-1.36	-73.36
2	467.31	-72.10	-57.00	-15.10	2.24	-74.34
3	740.72	-69.15	-57.00	-12.15	7.67	-76.82

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB).
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm).

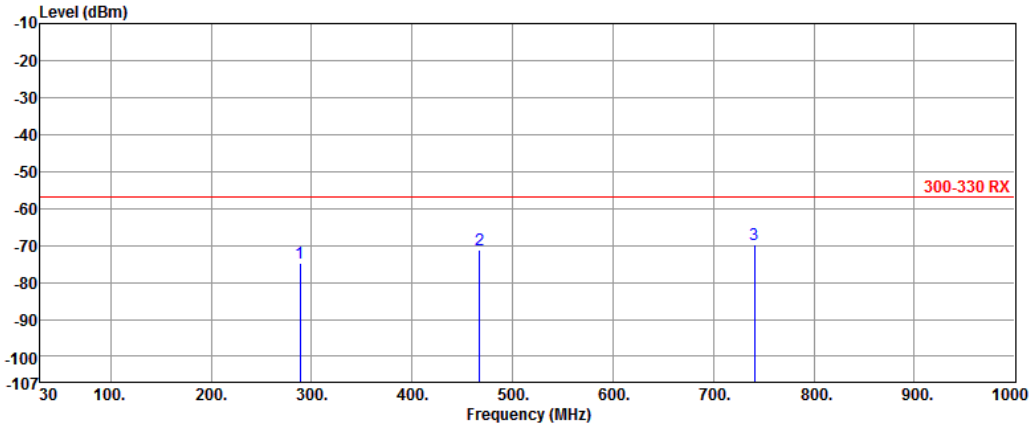
Polarization	Vertical	Test Configuration	1



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	288.37	-76.19	-57.00	-19.19	-1.91	-74.28
2	447.32	-71.05	-57.00	-14.05	1.90	-72.95
3	746.35	-67.56	-57.00	-10.56	7.81	-75.37

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB).
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm).

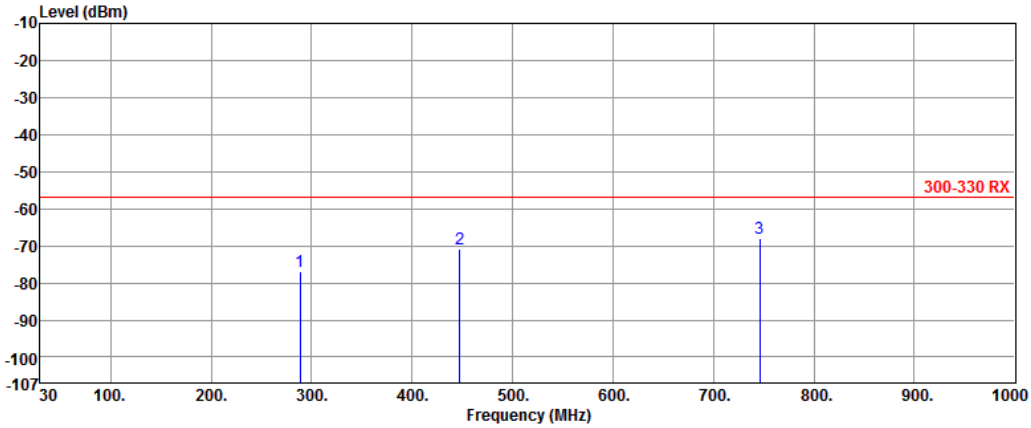
Polarization	Horizontal	Test Configuration	2



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	288.61	-74.73	-57.00	-17.73	-1.36	-73.37
2	467.39	-71.31	-57.00	-14.31	2.24	-73.55
3	740.56	-69.86	-57.00	-12.86	7.68	-77.54

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB).
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm).

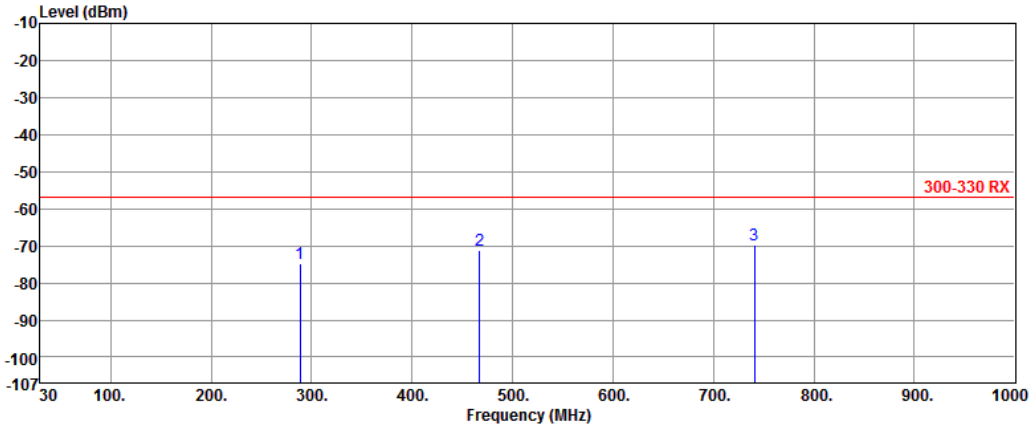
Polarization	Vertical	Test Configuration	2



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	288.39	-76.86	-57.00	-19.86	-1.91	-74.95
2	447.32	-70.75	-57.00	-13.75	1.90	-72.65
3	746.07	-67.94	-57.00	-10.94	7.80	-75.74

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB).
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm).

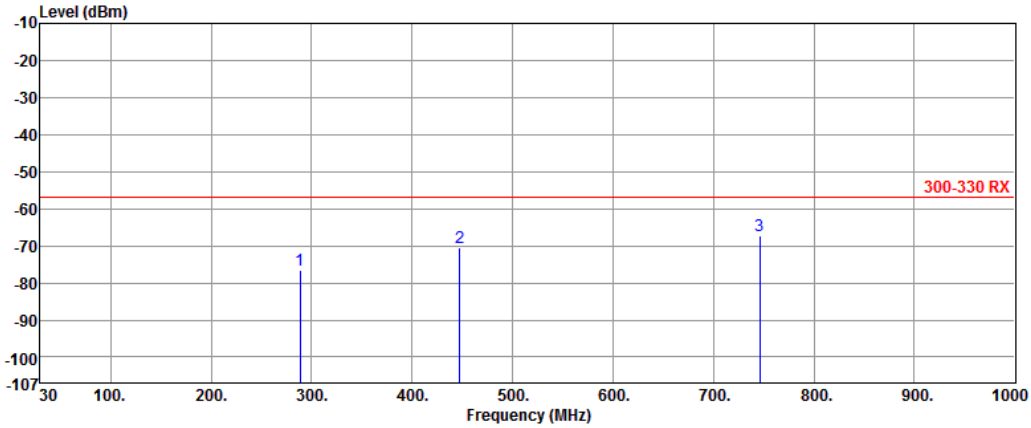
Polarization	Horizontal	Test Configuration	3



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	288.82	-74.86	-57.00	-17.86	-1.37	-73.49
2	467.50	-71.23	-57.00	-14.23	2.24	-73.47
3	740.74	-69.66	-57.00	-12.66	7.67	-77.33

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB).
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm).

Polarization	Vertical	Test Configuration	3

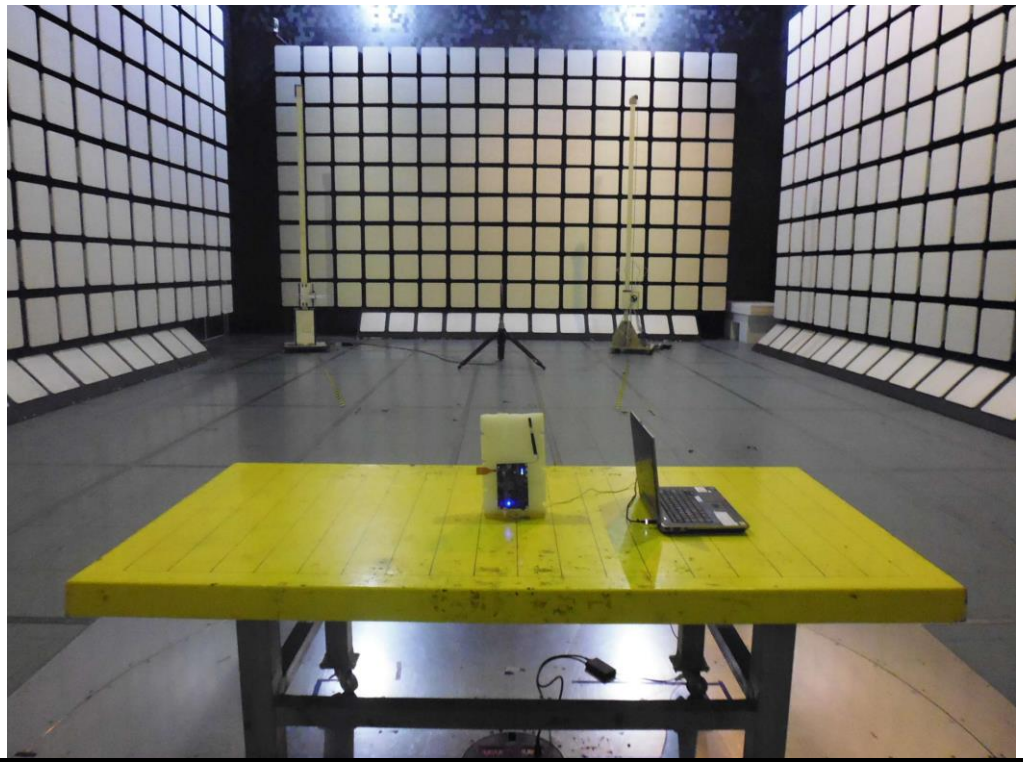


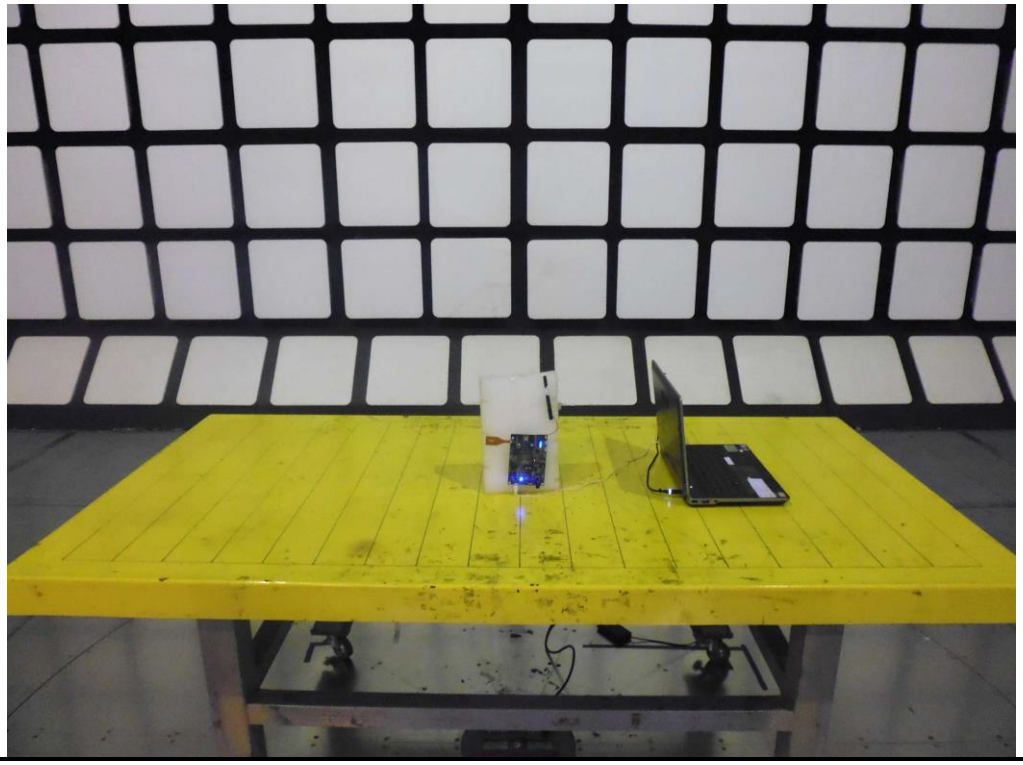
	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	288.80	-76.58	-57.00	-19.58	-1.91	-74.67
2	447.23	-70.32	-57.00	-13.32	1.90	-72.22
3	746.29	-67.34	-57.00	-10.34	7.81	-75.15

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB).
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm).

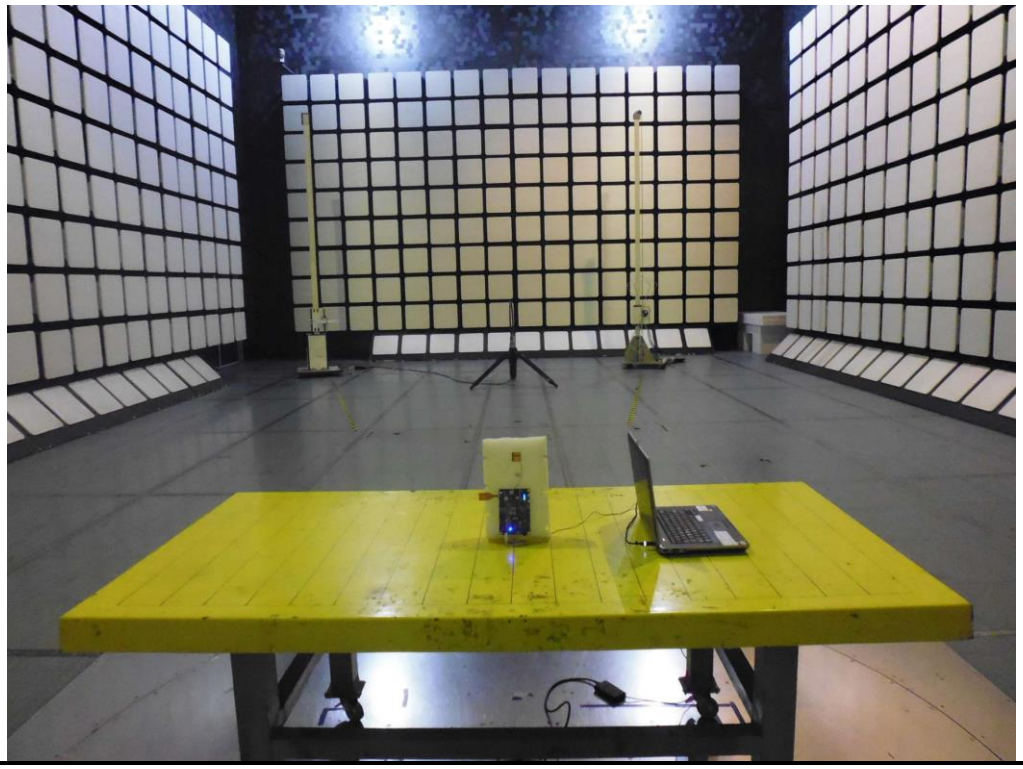
4 Photographs of the Test Configuration

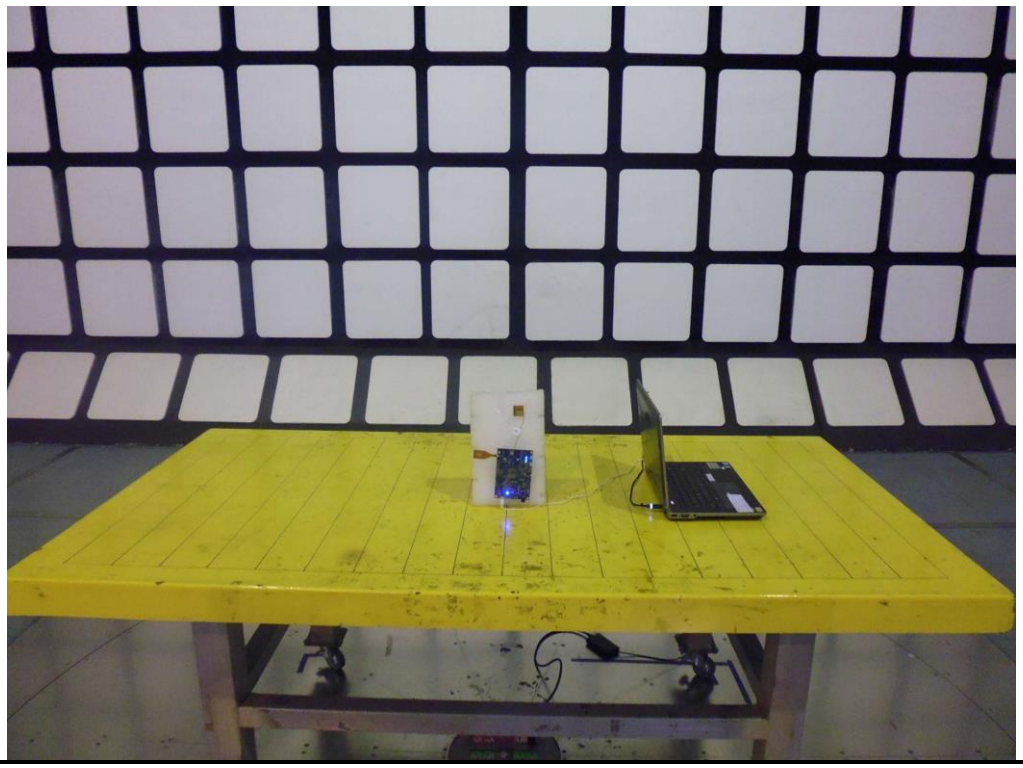
Below 30MHz (Test Configuration 1)



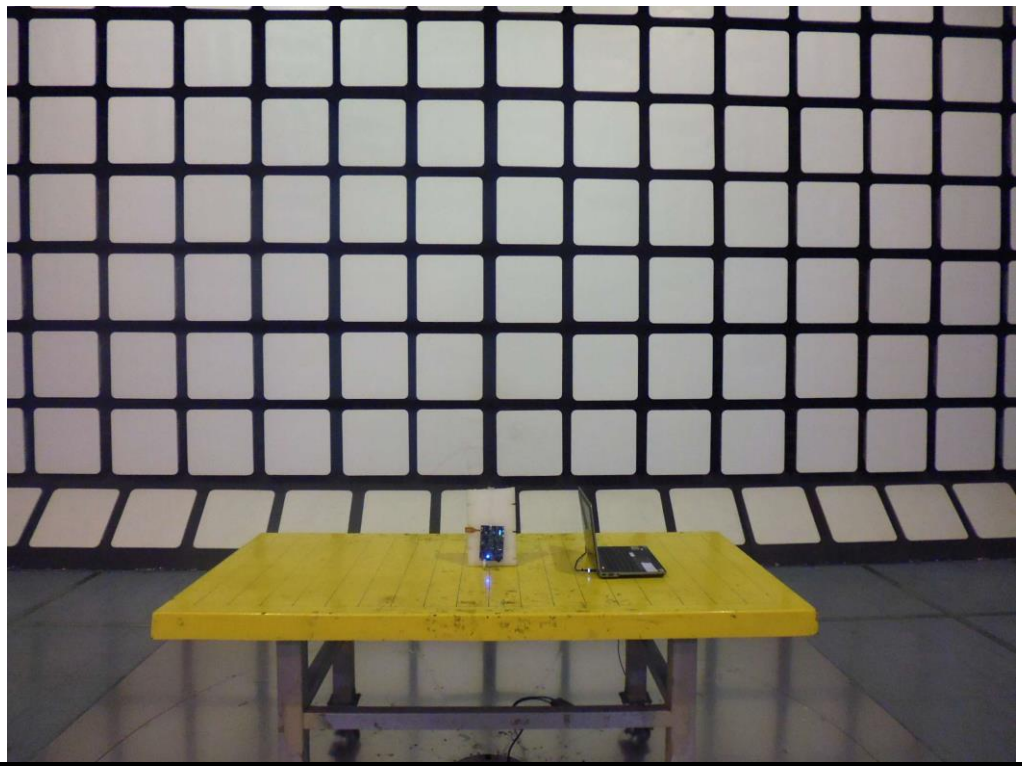


Below 30MHz (Test Configuration 2)

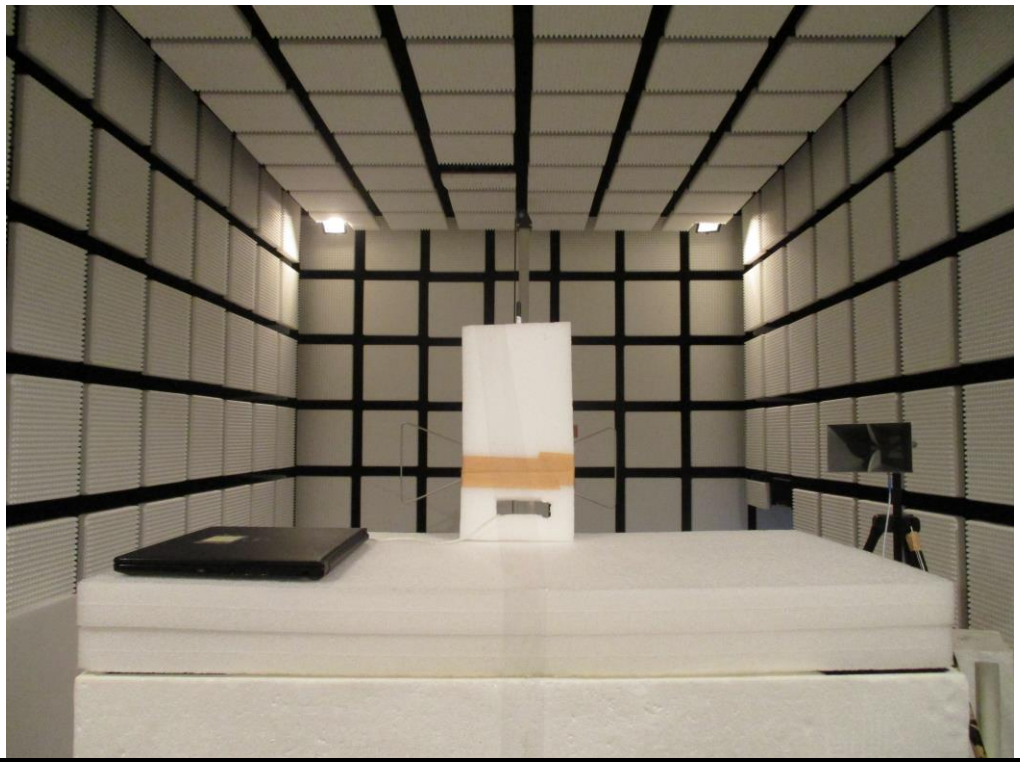




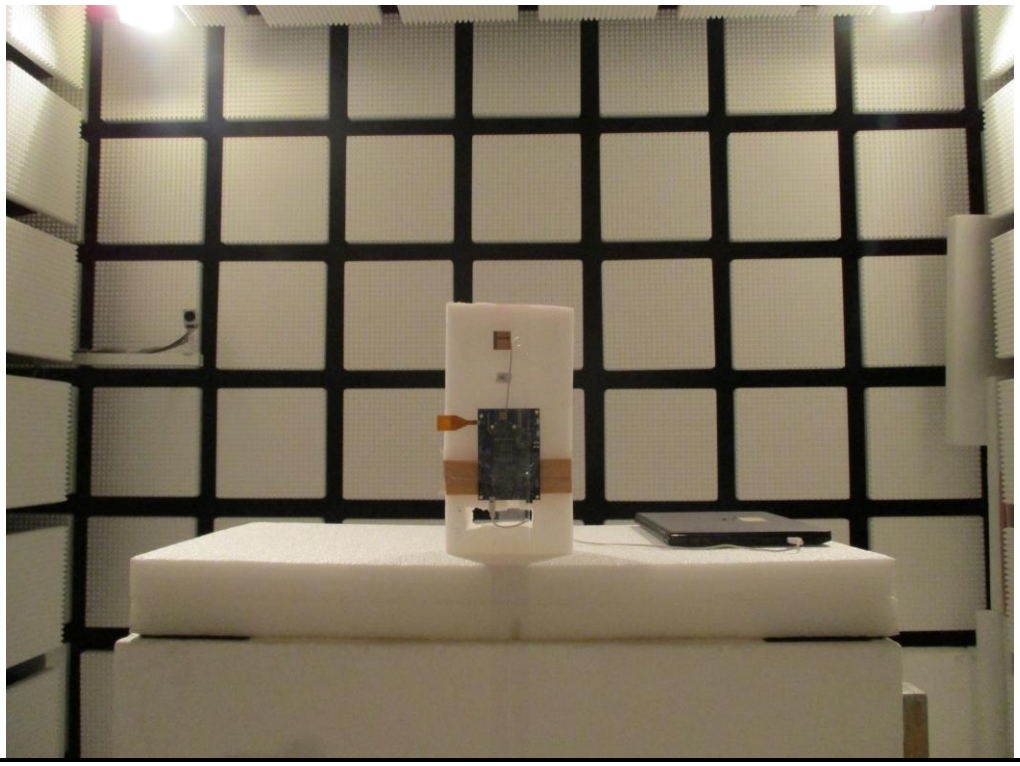
Below 30MHz (Test Configuration 3)

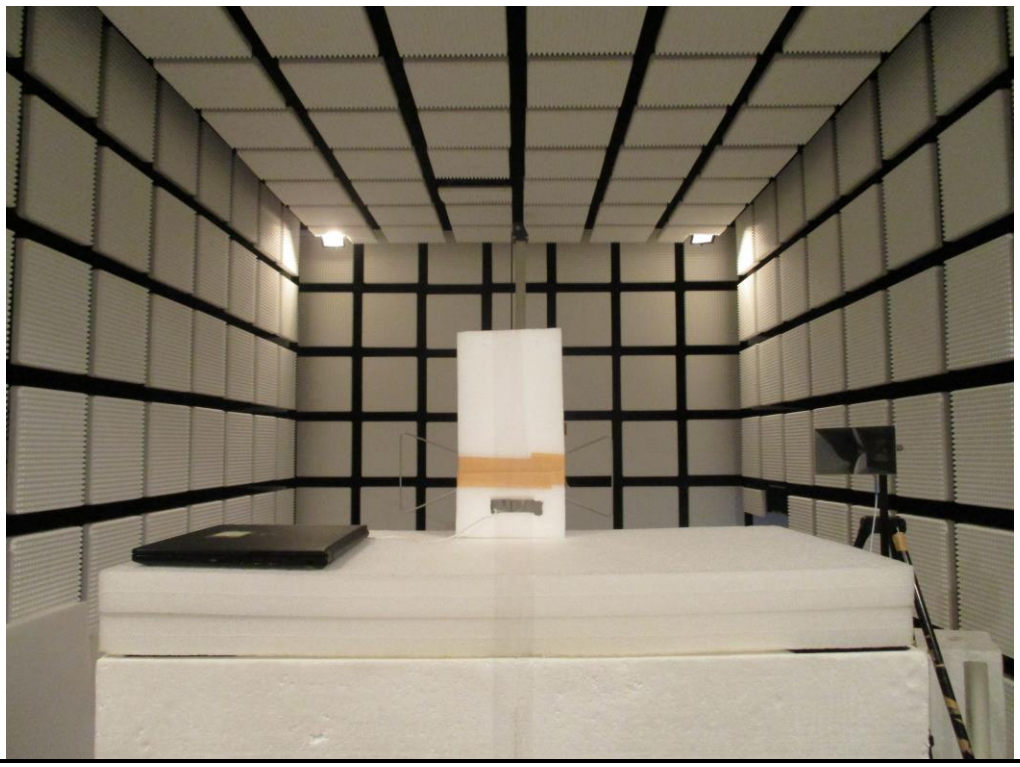


Above 30MHz (Test Configuration 1)

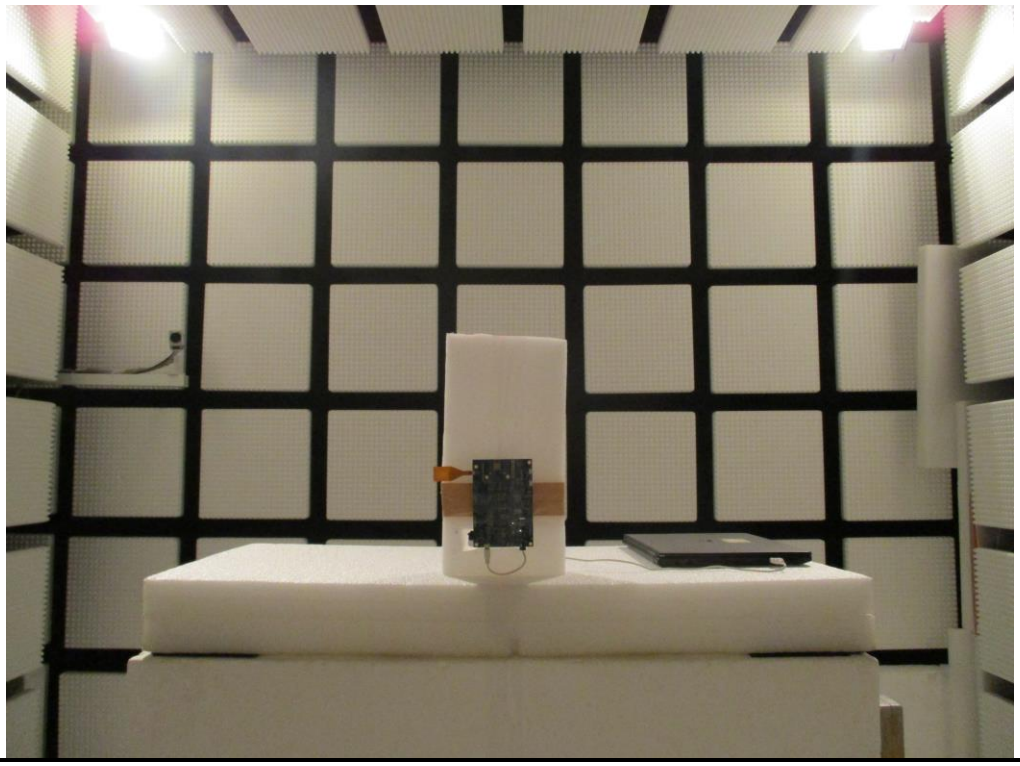


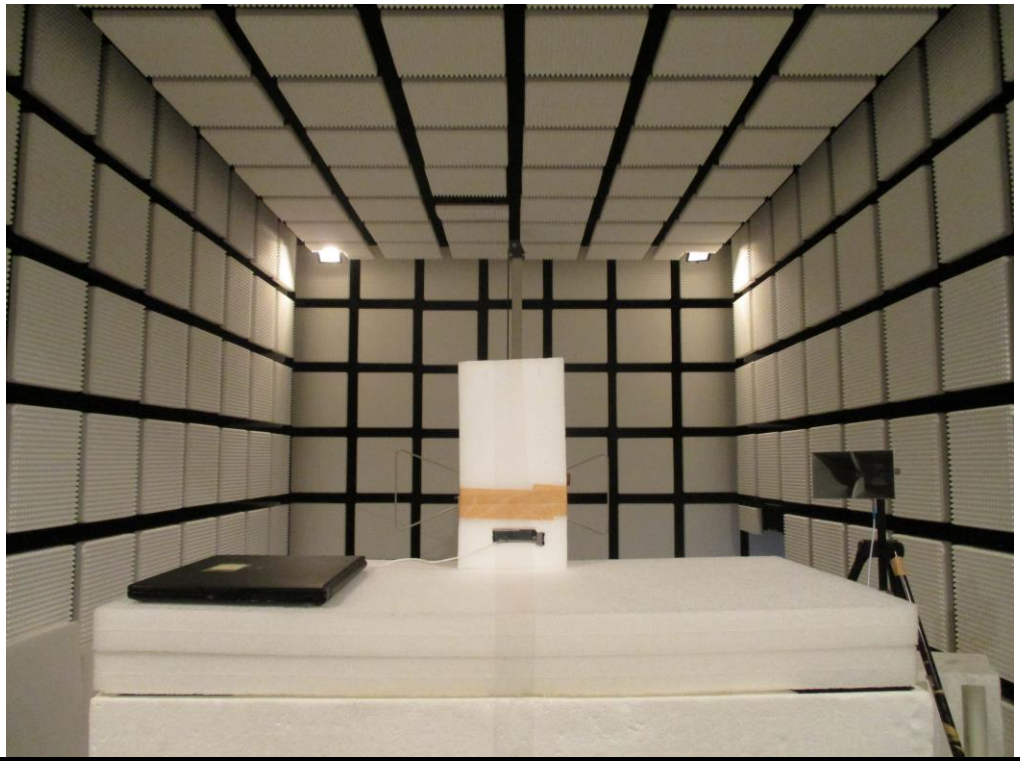
Above 30MHz (Test Configuration 2)





Above 30MHz (Test Configuration 3)





5 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C..

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666
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Email: ICC_Service@icertifi.com.tw

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